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On overshoots for the almost semi-continuous Poisson processes defined on a Markov chain

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Consider two-dimensional Markov integer process $\mathbf{Y}(t) = \{\xi(t), x(t)\} (t \geq 0, \xi(0) = 0)$, where $x(t)$ is finite ergodic Markov chain (MCh) with values in $\mathbb{E} = \{1, \dots, m\}$ and the generating matrix $\mathbf{Q} = \mathbf{N}(\mathbf{P} - \mathbf{I})$; $\xi(t)$ is lattice Poisson process given on MCh with values in \mathbb{Z} . Its moment generating function (m. g. f.) has an exponential form $\mathbf{g}_t(z) = \|E[z^{\xi(t)}, x(t) = r | x(0) = k]\| = \mathbf{E}z^{\xi(t)} = e^{t\mathbf{K}(z)}$, where matrix cumulant function $\mathbf{K}(z)$ is determined by general matrix relation

$$\mathbf{K}(z) = \sum_{x \neq 0} (z^x - 1) \mathbf{\Pi}_0(x) + \mathbf{Q}, \mathbf{\Pi}_0(x) = \mathbf{\Lambda} \mathbf{p}(x) + \mathbf{N} \mathbf{f}(x),$$

$\mathbf{\Lambda} = \|\delta_{kr} \lambda_k\|$ ($k = 1, \dots, m$), λ_k are jumps intensities of Poisson processes $\{\xi_k(t)\}_{k=1}^m$ with jumps distribution $\mathbf{p}(x) = \|\delta_{kr} P\{\xi_1^{(k)} = x\}\|$, $\mathbf{N} = \|\delta_{kr} n_k\|_{k,r \in \mathbb{E}}$, where $\{n_k > 0, k \in \mathbb{E}\}$ - parameters of the exponential distributed random variables ζ_k are sojourn time $x(t)$ in the state k . Matrix of transition probabilities of embedded MCh $y_n = x(\sigma_n + 0)$, where σ_n are moments of n -th change of states for $x(t)$: $\mathbf{P} = \|p_{kr}\|$, ($k, r = \overline{1, m}$), $\mathbf{f}(x) = \|p_{kr} P\{\chi_{kr} = x\}\|$ is a distribution of jumps on transitions of $x(t)$. For the full definition of the process $\mathbf{Y}(t)$ in latticed cases see [1].

We study the distributions of overshoots for the almost semi-continuous processes (process, for which the jumps of same sign are geometrically distributed and jumps with opposite signs have arbitrary lattice distribution), defined on a MCh. For these processes, we get the limit distributions of overshoots over the infinitely far and zero levels.

REFERENCES

- [1] Herych M.S. Refinements of basic factorizational identity for almost semi-continuous lattice processes on Markov chain// Carpathian mathematical publish papers. - 2012. - V.4, 2. - P. 229-240.

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